

Crustal Soil Attenuation of Gamma Photons

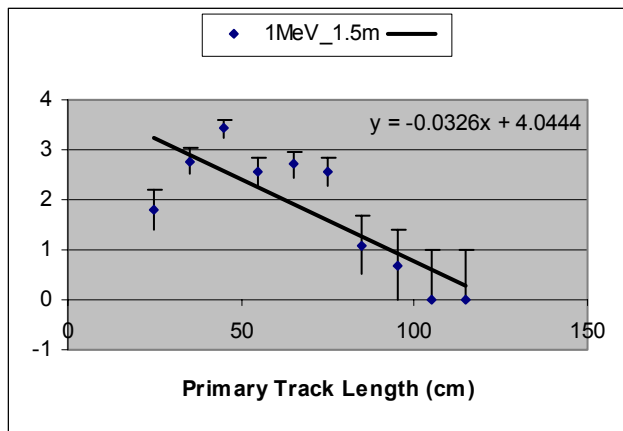
Feb 2, 2006

Kevin Lee

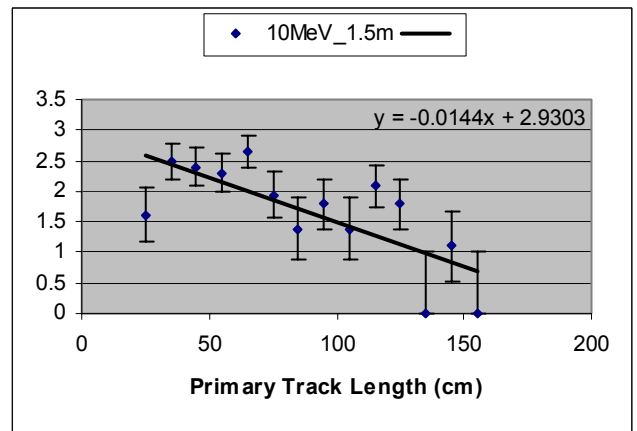
A series of Geant4 runs is done for a simple geometry of slab layers (using the Geant4 novice N03) of Earth's crust composition [see internet], for different gamma photon energies directed perpendicular to the slabs and for 100 events each run. The plots are $\ln(N)$ vs. primary track lengths to show an attenuation of the primary tracks through the layers. The characteristic attenuation lengths are given as lambdas. The density used is 2 g/cc and should be higher, but no more than ~ 5 g/cc. There are large "plumes" or showers mostly forward beyond the primary tracks. It should be possible for the NOvA detector to discriminate against shower plumes that are originating outside or at the surface of the detector. The gammas above 100 MeV have the lambdas below 50 cm. It appears to be that the gammas around 10 MeV to 100 MeV slip-in more easily through the slabs. This doesn't mean that the higher energy gammas don't have the penetrating power.

There are gammas, e^- and e^+ in the shower plumes always and there should also be pions including π^0 's for the original gammas above the 140 MeV.

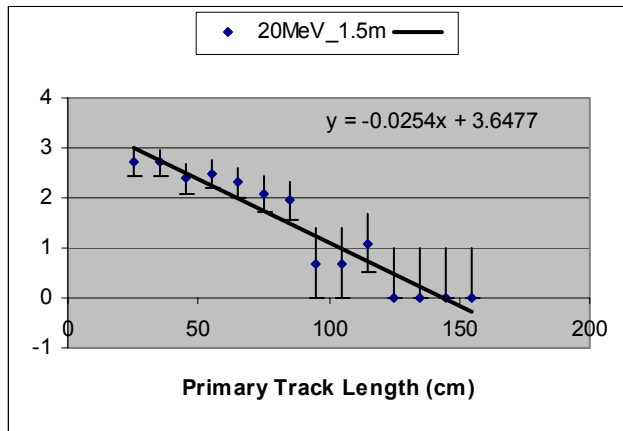
In the far detector concept with an overburden, cosmic gamma photons can be attenuated 20 times to 50 times with a 1 1/2 m overburden as long as the subsequent showers can be discriminated by the NOvA detector. In the future runs, more counts will be sampled and also will look at the π^0 's.



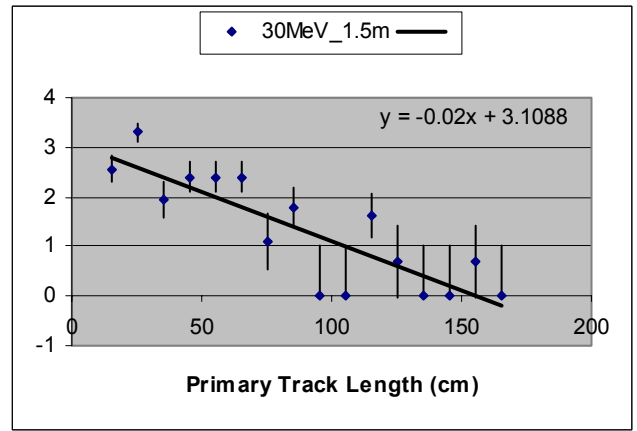
rho=2 g/cc, lambda=31 cm.



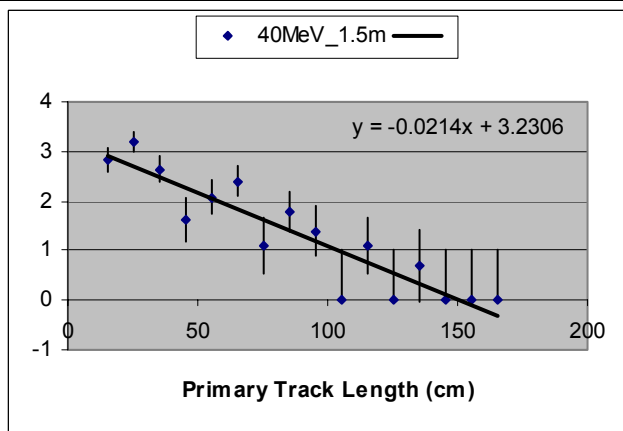
rho=2 g/cc, lambda=70 cm.



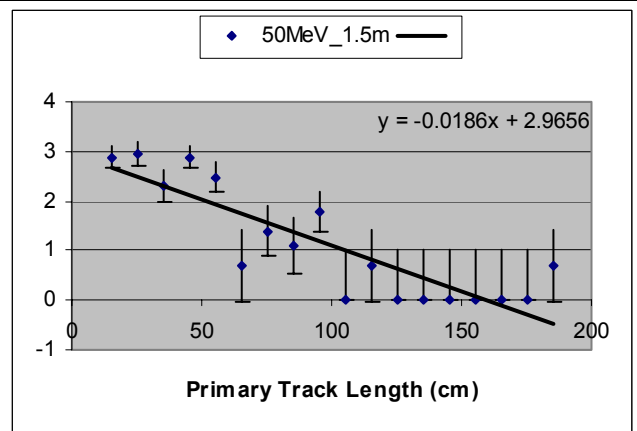
rho=2 g/cc, lambda=39 cm.



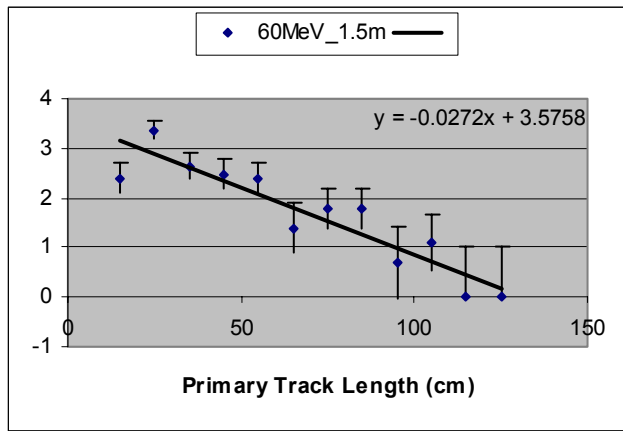
rho=2 g/cc, lambda=50 cm.



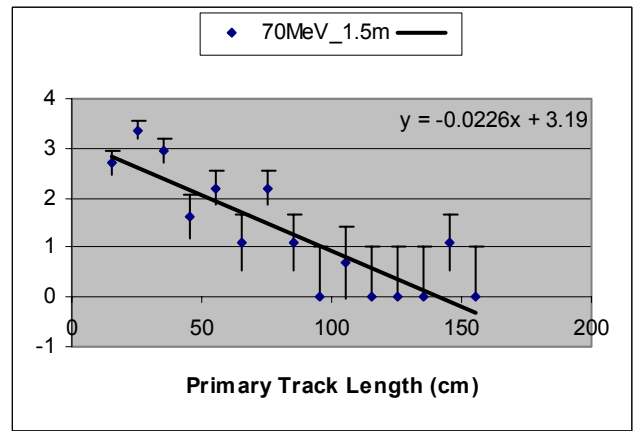
rho=2 g/cc, lambda=47 cm.



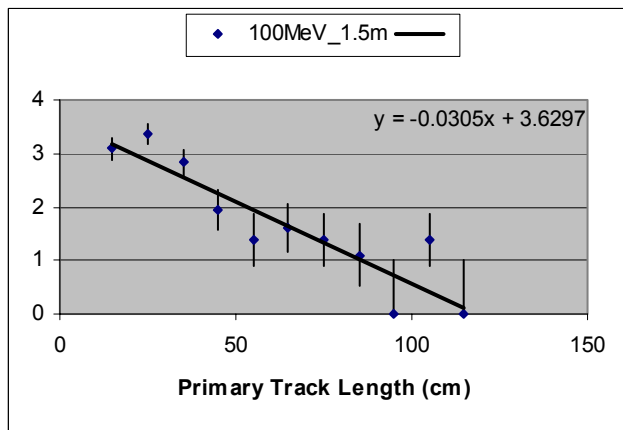
rho=2 g/cc, lambda=54 cm.



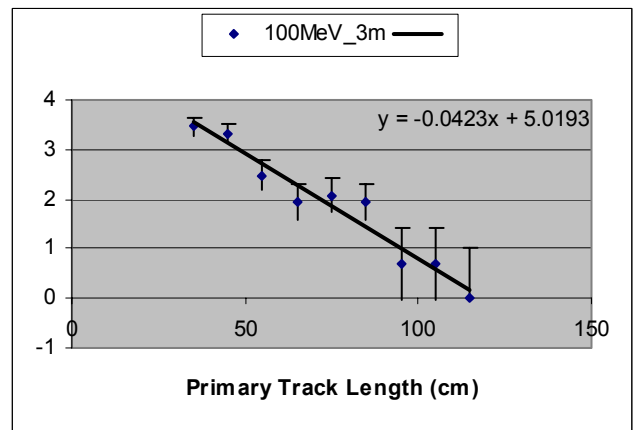
rho=2 g/cc, lambda=37 cm.



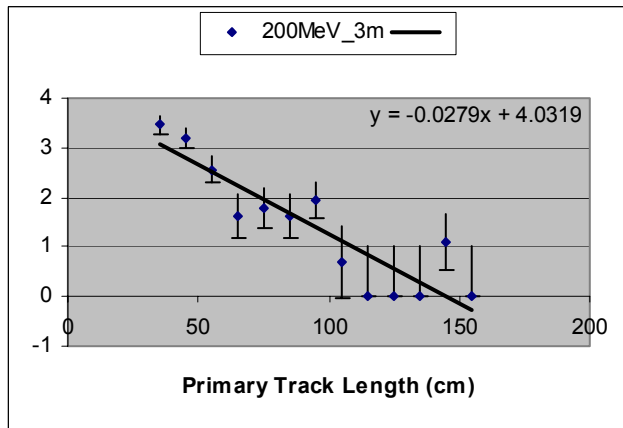
rho=2 g/cc, lambda=44 cm.



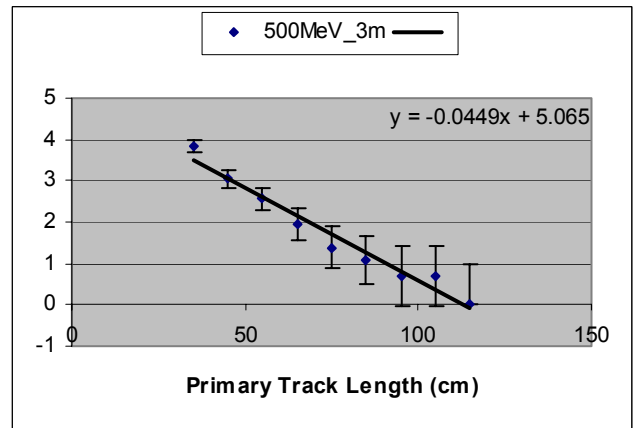
rho=2 g/cc, lambda=33 cm.



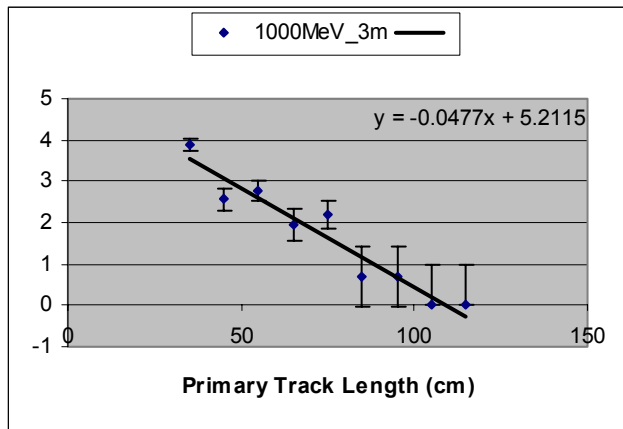
rho=2 g/cc, lambda=24 cm.



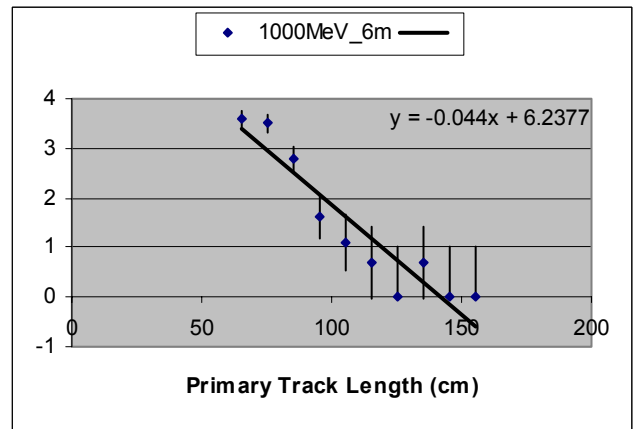
rho=2 g/cc, lambda=36 cm.



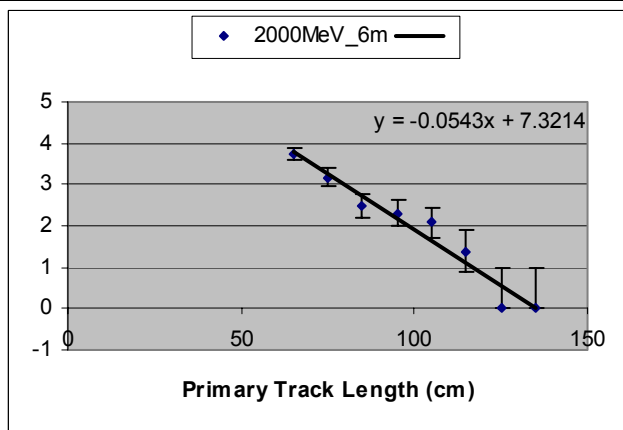
rho=2 g/cc, lambda=22 cm.



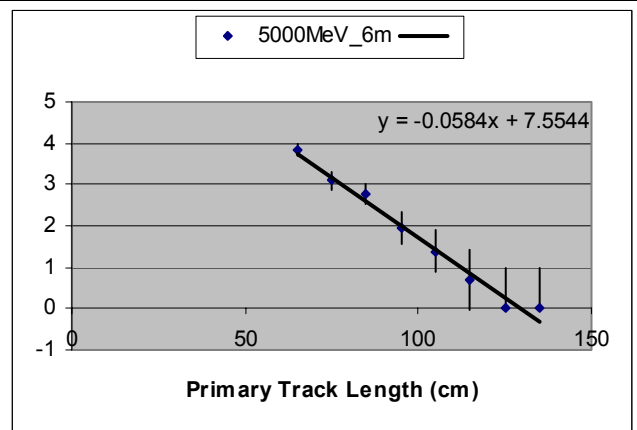
rho=2 g/cc, lambda=21 cm.



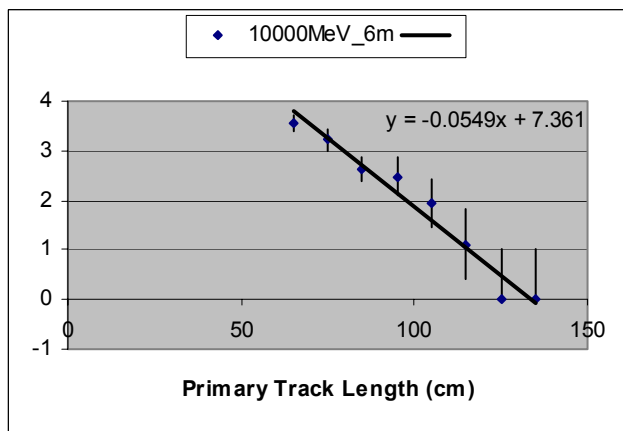
rho=2 g/cc, lambda=23 cm.



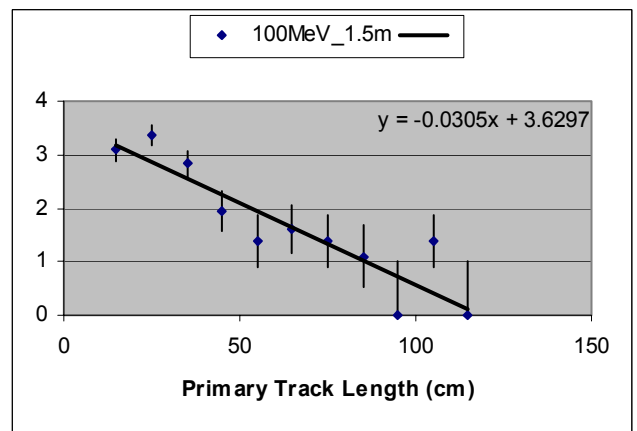
rho=2 g/cc, lambda=18 cm.



rho=2 g/cc, lambda=17 cm.



rho=2 g/cc, lambda=18 cm.



rho=2 g/cc, lambda=33 cm.